The Biology and Description of a New Species of African *Thyreus*, with Life History Notes on Two Species of *Anthophora* (Hymenoptera: Anthophoridae)

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Abstract: Information is given on the life history of the cuckoo bee *Thyreus* **lieftincki** and on its host, *Anthophora braunsiana* Friese. Biological data are also presented on *Anthophora krebsi* Friese, the nests of which are attacked by the cuckoo bee *Coelioxys* (*Liothyrapis*) *lativentris* Friese. The adults of *T.* **lieftincki**, new species, are described.

Because nothing has been recorded concerning the mode of parasitism of the melectine bee genus *Thyreus*, information on the life history of the South African *Thyreus* **lieftincki**, new species, is presented here. The biologies of its host, *Anthophora braunsiana* Friese, and *Anthophora krebsi* Friese, which nested near the latter, are also discussed and the taxonomic description of *T.* **lieftincki** is appended.

Female specimens of *A. braunsiana* were found to be conspecific with a type of the species in the Institut für Spezielle Zoologie und Zoologisches Museum, Humboldt-Universität, Berlin. This type, bearing the orange "typus" label of Friese, identified in 1904 and collected in Capeland by Krebs, is almost certainly one of the specimens examined by Friese (1905) for his description of the species. Other specimens labeled "*braunsiana*" both in the Berlin Museum and in the British Museum (Natural History) are not conspecific with either the type or the specimens discussed here. The females referred to as *A. krebsi* in the present paper are identical to a female in the Berlin Museum identified as *krebsi* by Friese in 1910. All specimens of both species of *Anthophora* and of the parasitic bees collected in connection with this study are in the American Museum of Natural History and in the Snow Entomological Museum, the University of Kansas, Lawrence.

The identification of the bees was possible because of the generous assistance of the following people and their institutions: Dr. Eberhard Königsmann, Institut für Spezielle Zoologie und Zoologisches Museum, Humboldt-Universität, Berlin; Dr. L. Vári and the late Dr. G. van Son, Transvaal Museum, Pretoria, Republic of South Africa; and Dr. I. H. H. Yarrow and Mr. Collin Vardy, British Museum (Natural History), London. I would like to express my appreciation to Dr. M. A. Lieftinck, Rijksmuseum van Natuurlijke Historie,

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Leiden, The Netherlands, for examining specimens of *Thyreus* **lieftincki** and for preparing the drawings of the male genitalia. The other illustrations are by Mr. Anthony D'Attilio and Mrs. Marjorie Favreau. Dr. Charles D. Michener, the University of Kansas, compared specimens of *T.* **lieftincki** with the type of *T. valvata* in the British Museum, and Prof. J. J. Pasteels, Université Libre de Bruxelles, kindly confirmed the identification of *Coelioxys lativentris*.

BIOLOGY

The biological aspect of this study was conducted 3 miles south of Avontuur, Cape Province, Republic of South Africa, on November 15 and 16, 1966, at an elevation of 3500 feet. The burrows of *Anthophora krebsi* were found in a vertical roadside embankment about six feet high (Fig. 1), whereas *A. braunsiana* nested in the mounds of the termite, *Amitermes hastatus* (Haviland)[2], scattered on the same bank. Because some of the nests of *A. krebsi* were only a few inches from the termite mounds, these two bees seem specific in their selection of different nesting situations. Facing north, the bank and termite mounds were exposed to the sun during most of the day, and plants growing on top of the bank did not cast a dense shadow. *Hoplitis anthodemnion* Michener was the most abundant bee nesting in the bank during the period of observations, and an anthidiine and probably a number of other anthophorines may have used the bank previously. No bee other than *A. braunsiana* nested in the termite mounds.

Nesting Activities of *Anthophora braunsiana*

Although nesting in several termite mounds, this species was studied in the mound in which it was most abundant. Approximately 30 entrances occurred on the top and middle of the north-facing surface of the mound, which was about 30 cm. across. Most burrows led to active nests though some burrows also connected to cells from previous generations. All active burrows were open and lacked tumuli and turrets. In constructing burrows, females of *A. braunsiana* had used existing cavities where they occurred, had walled-off passageways to active termite galleries, and had excavated holes between galleries. The burrows were 6.5 to 7.0 mm. at their smallest diameter and elsewhere conformed to the size of the existing termite gallery.

The main burrow generally descended moderately in a jagged course for a straight-line distance of 4 to 8 cm. Typically the cells were clustered at the end of the burrow in several linear series, sometimes with as many as four cells in a row. Cells (Fig. 2) in a series were closely connected and sometimes arranged at angles, one to another. Each cell was oriented so that its rear was lower than its front, and those closest to the burrow abutted it.

[2] Kindly determined by Dr. Kumar Krishna.

Fig. 1. Nesting site of *Anthophora braunsiana* and *krebsi*, 3 miles south of Avontuur, Cape Province, Republic of South Africa.

The female bee excavates a cavity for the cell, and, then by cementing together fine pieces of termite carton, it constructs the hard, dark gray, cell wall, approximately 1 to 2 mm. thick. If a cavity is too large for a cell, the excess space is filled first with fine uncemented carton, over which the hard wall is then cemented. The wall is lined inside all over with a thick, waterproof coating of wax, which can be easily scraped with a knife. The inside of the cell cap is concave, lined with wax, and smooth except for a central dimple, presumably where the female withdrew her tongue. The outer surface is nearly flat and smooth. The cap has a center about 1 mm. thick and a periphery 2 mm. thick. The lumen of the finished, ovoid cell is 12.0 mm. long and approximately 8.5 mm. in maximum diameter. Each cell (Fig. 2) is a complete unit encased by the hard cell wall and cap, and, therefore, cells in series can be separated without being damaged.

Though the female transports pollen dry to the nest, she adds liquid (nectar?) so that the stored provisions are a moist, homogeneous paste, deposited in the rear of the cell. The surface of the provisions of a freshly closed cell is perhaps more liquid than the rest of the provisions. Even food masses that are not yet complete have a distinct sour-milk smell, an odor different from that emanating from the cells of *Svastra* (Rozen, 1964). Fermentation apparently sets in and

the provisions may swell somewhat. A white substance, presumably a yeast, coats the cap and walls of cells in which larvae are feeding. The depth of the provisions at the time the egg hatched was about 7 to 8 mm. in one case.

The egg (Fig. 2), approximately 4.4 mm. long and 1.0 mm. in maximum diameter (one measurement), is deposited on top of the food mass. White, with a dull chorion, it is slightly curved and rounded at both ends. At the time of hatching, the egg develops a shiny stripe along each side, just as was reported for *Svastra* (Rozen, 1964). The larva of *A. braunsiana* feeds as it moves around the circumference of the pollen mass. Consequently, by the time the larva grows moderately large, a center pillar of pollen projects upward and the larva surrounds it (Fig. 3).

The larva does not begin to defecate until sometime after it has consumed the provisions. Feces are applied over the entire cell wall, possibly including the cap, and no cocoon is spun. The inactive larva rests with the anterior part of its body closest to the cell closure (Fig. 4), and moves slowly from time to time. Its integument is soft, not rigid like that of the Panurginae which also do not spin cocoons. Several larvae pupated before December 10, 1966 but others still had not pupated in the laboratory by July 1, 1968.

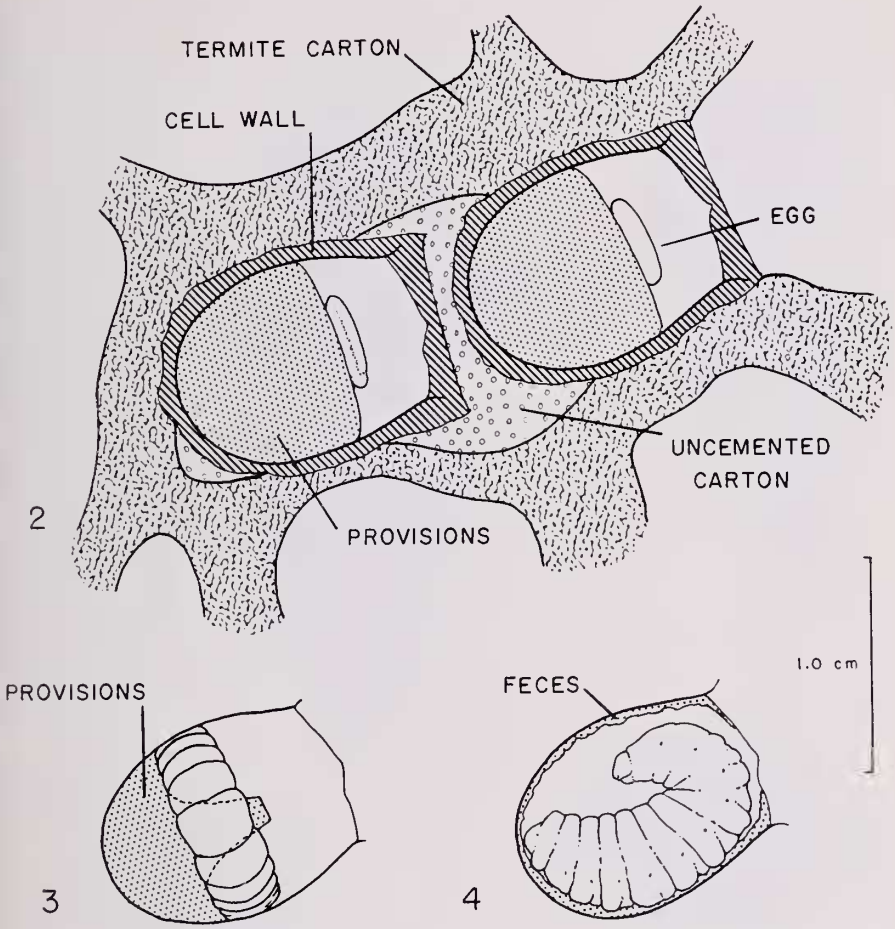
Larvae and eggs of *Thyreus* **lieftincki** were the most common nest associates encountered. However, a meloid larva and a mutillid cocoon were also discovered, and mites occurred in many cells. In some cases termites had penetrated the cell walls and killed the *Anthophora* larvae.

Nesting Activity of *Anthophora krebsi*

Several nests of *A. krebsi* were excavated from the vertical hard earth bank. The burrow, without turrets, 6.0 to 7.0 mm. in diameter, and circular in cross section, entered the bank perpendicularly and then immediately descended. It again ran nearly horizontal before reaching the horizontal to slightly tipped cells. Although the burrow usually had no special lining, either secreted or constructed, the female of *A. krebsi* had blocked a side tunnel from an older nest in one case, an act indicating that parts of old burrows could be altered and used by subsequent generations.

Like those of *A. braunsiana*, the cells of this species are provided with a special built-in lining, in this case consisting of cemented soil. The hardened wall, slightly less than 1 mm. thick, often permitted the cells to be removed intact from the bank. The wax lining is considerably thinner than the cell lining of *A. braunsiana*. The closure is identical to that of *A. braunsiana* in shape but apparently lacked a wax lining and is slightly thinner. Cells measure 11.0 to 12.0 mm. long and 8.0 to 9.0 mm. wide.

The yellow moist provisions fill the rear of the cell to a depth of about 7.0 mm. One cell, being provisioned, contained a nearly clear liquid on which floated pollen. The liquid, which emitted the sour-milk smell found in the cells



Figs. 2–4. Cells of *Anthophora braunsiana*. 2. Containing egg; one at left about to hatch. 3. With intermediate larva feeding on provisions. 4. With postdefecating larva and feces.

of *A. braunsiana*, may inoculate provisions so that they undergo proper fermentation.

An adult of the cuckoo bee *Coelioxys* (*Liothyrapis*) *lativentris* Friese was captured while investigating the burrows of *A. krebsi*, and a mature *Coelioxys* larva, presumably of this species, was recovered from one of the cells. This is believed to be the first record of a *Coelioxys* parasitizing an *Anthophora* cell.

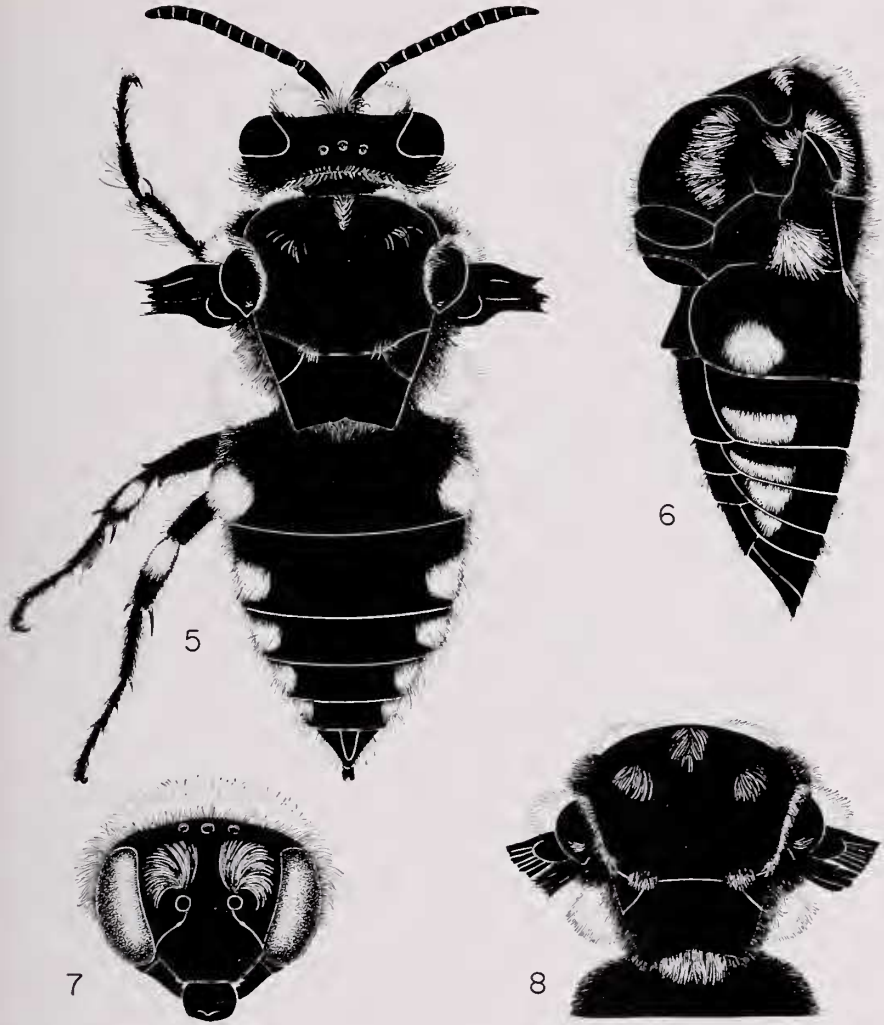
Habits of *Thyreus*

Adults of *T.* **lieftincki** were associated only with the nests of *Anthophora braunsiana*; they probably do not attack the nests of *A. krebsi*. One female flew from burrow to burrow on the termite mound and poked her head into

each entrance before going to the next. She entered several burrows but came out in less than a minute. After examining about eight entrances, she entered one and, 15 to 20 minutes later, a female *Thyreus* flew out. When the nest was excavated, another female *Thyreus* was discovered inside; whether she was the female observed outside or one that was already in the nest could not be determined.

Eggs of this *Thyreus* are inserted through a small hole in the cell cap and apparently drop onto the provisions. None was found cemented to the cap as is the case with *Zacosmia maculata* (Cresson) (Torchio and Youssef, 1968). However, if weakly cemented, they may have been dislodged by vibrations created by my digging. In some instances it appears that the opening ("micropyle" of Torchio and Youssef, 1968) through which the *Anthophora* tongue was withdrawn is used by the *Thyreus* female, but in other cases a separate small puncture just large enough to accommodate the egg and presumably the tip of the female's abdomen, was visible on the inside. There is some suggestion that the *Thyreus* female closes such punctures on the outside, for parasitized cells often have a few raised, rough granules on the outer surface of the cell cap. Torchio and Youssef (1968) claimed that *Zacosmia* females plug the oviposition holes. As many as five eggs of *Thyreus* were found in a cell though some cells contained single eggs. They are white, nearly straight, and, in general, somewhat similar in appearance to those of *A. braunsiana*, only more slender. They measure 3.5 to 3.75 mm. long (five measurements) by 0.55 to 0.65 mm. in maximum width (four measurements).

Upon hatching, the young larva crawls from the chorion which then collapses. The first instar is slow-moving, linear in shape, and possesses a pigmented head capsule with large pointed mandibles. With these mandibles, it kills the egg, or possibly the young larva, of the host, and its siblings. The first instar will be described in a subsequent paper; however, it is similar to that of *Melecta luctuosa* (Scopoli) (Giordani-Soika, 1936), of *M. pacifica* Cresson (Torchio and Youssef, 1968), and of *Zacosmia maculata* (*ibid.*). The older larva, except for its longer antennae, is almost indistinguishable from that of its host on superficial examination. The *Thyreus* larvae, unlike those of *A. braunsiana*, begin defecating before they complete the provisions. Although they may eat a small amount of food while defecating, the provisions are not entirely consumed. The feces are applied over the entire cell wall, including the cap. The postdefecating larva curls itself tightly but can move quickly, twisting and straightening its body at the same time. In this action, it is distinct from the slow-moving larva of *A. braunsiana*. The integument of the postdefecating form, like that of *A. braunsiana*, is nonrigid. The mature larva, which is being described elsewhere, does not spin a cocoon and thereby differs from *Melecta* and *Zacosmia*.



Figs. 5–8. Schematic illustrations of adults of *Thyreus* **lieftincki**, showing distribution of white hair markings. 5. Female, dorsal view. 6. Female, lateral view. 7. Head of female, frontal view. 8. Mid-body region, male, dorsal view.

The biology of *T.* **lieftincki**, except where noted, agrees closely with the observations of Torchio and Youssef (1968) on *Zacosmia maculata*.

Thyreus **lieftincki**, new species

DIAGNOSIS: The four adult specimens upon which the following description is based are believed to represent a distinct species. Adults of previously described

South African forms have been examined in the British Museum (Natural History), London, the Museum National d'Histoire Naturelle, Paris, the Institut für Spezielle Zoologie und Zoologisches Museum, Humboldt-Universität, Berlin, and the Transvaal Museum, Pretoria, and none was found to be conspecific with *T.* **lieftincki**. This species keys to *valvata* (Brauns) in Brauns (1909) and to *vachali* (Friese) in Meyer (1921), but, according to Meyer, *valvata* is a junior synonym of *vachali*. Although the type of *vachali* has not been examined, the specimens of *T.* **lieftincki** are not conspecific with a cotype and other specimens of *valvata* in the British Museum.

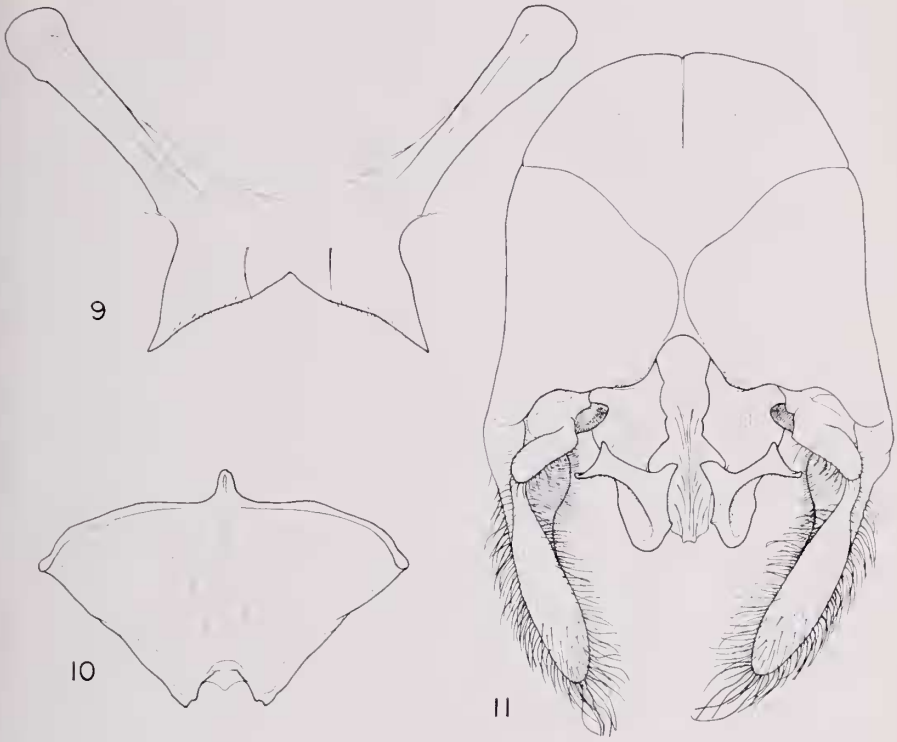
The white hair markings of *T.* **lieftincki** (Figs. 5–8) and of *valvata* are much reduced compared with those of most other South African forms, but they are even more restricted in *T.* **lieftincki**. The absence of white hairs on the genae, femora, tarsi, and anterolateral angles of the first metasomal tergum immediately distinguishes *T.* **lieftincki** from *valvata*.

Lieftinck's (1962) terminology of the thoracic white hair markings is adopted below.

FEMALE: Body size approximately 12 mm., slightly larger than that of *valvata*. Integument of body and legs black; punctation of clypeus and thoracic dorsum moderately dense but slightly coarser than that of *valvata*; punctation of dorsum of metasoma moderately dense, similar to that of *valvata*. Antennae moderately short; most flagellar segments a little wider than long. Ocelli slightly smaller than those of *valvata*; face with median, interantennal ridge somewhat less pronounced than in *valvata*; clypeus less protuberant than that of *valvata*. Legs as in *valvata* except middle and hind tibiae somewhat narrower toward apex; hind femur without tooth. Wings infuscated except for subhyaline spots beyond veins on forewing and except for more hyaline base of hind wings.

PUBESCENCE: Light hairs white. White hairs on face (Fig. 7) long, erect, suberect and restricted to two patches, each above and laterad of antennal socket; by contrast, these patches much more extensive in *Valvata* on which they also occupy part of clypeus and subantennal area; genal and postgenal hairs dark, not white as in *valvata*. Both black and white hairs of thorax erect, long, nonscale-like; thoracic white hair markings (Figs. 5, 6) reduced and either less conspicuous than those of *valvata* or absent; mediolateral scutal spots reduced to few white hairs; posterolateral scutal spots inconspicuous though present; parategular scutal spots (*plsa* of Lieftinck, 1962) narrow but elongate, extending entire length of each tegula; scutellum and axillae like those of *valvata* without white spots; tegular spots consisting, at most, of only a few white hairs; ventral episternal light hairs absent, unlike those of *valvata*. Rear coxae with small outer apical tuft of white hairs; other coxae, all trocanters, and all femora with only dark hairs; anterior tibia (Fig. 5) with posterodorsal patch of white hairs; middle tibia (Fig. 5) with white patch reduced to basal two-thirds of dorsal surface; hind tibia (Fig. 5) with white patch reduced to base of one-half to two-thirds of dorsal surface; all tarsi with only dark hairs. White hairs of metasoma decumbent but not appressed; white hair patches on each tergum small, widely separated (Fig. 5); white patches of first metasomal tergum restricted to posterolateral angle of tergum; all hairs on metasomal sterna dark.

MALE: As described for female except as follows: Antennae missing. Hind basitarsus with outer surface somewhat incurved. Genitalia and metasomal sterna VII and VIII as illustrated (Figs. 9–11).



Figs. 9–11. *Thyreus* **lieftincki**, apical metasomal sterna and genitalia of allotype, ventral view. 9. Metasomal sternum VII. 10. Metasomal sternum VIII. 11. Genitalia.

PUBESCENCE: As in female except for following: White hairs on dorsum of thorax (Fig. 8) somewhat more conspicuous so that mediolateral scutal spots moderately evident; middle coxa possibly with a few white hairs on outer side.

TYPE MATERIAL: Holotype female, one female paratype (mounted on pin), one female paratype (in alcohol), and allotype, 3 miles south of Avontuur, Cape Province, Republic of South Africa, November 15, 1966, J. G. Rozen; in collection of the American Museum of Natural History.

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